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A Meta-Analytic Structural Equation Modelling on the Unified Theory of Acceptance and Use of Technology in Higher Education

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Abstract

With technology advancements in society, many theories and models evolved for explaining the technology acceptance of people in different contexts, especially in education. This study's main objective is to confirm the factors influencing the actual use behaviour of technology in the higher education sector, based on the framework of the unified theory of acceptance and use of technology (UTAUT). This objective was executed by means of the modern statistical technique, meta-analytic structural equation modelling (MASEM). This study synthesized 44 samples from 38 quantitative studies of UTAUT constructs, covering 16550 participants in higher education institutions. The result confirms the validity of the UTAUT model, except the direct effect of facilitating conditions on use behaviour. Therefore, performance expectancy, effort expectancy, social influence and facilitating conditions are the significant positive predictors of the teachers and students' behavioural intention to use the technology. The behavioural intention can also significantly predict the actual technology use behaviour of teachers and students. Moreover, the resulted model can explain the higher variance of the technology use behaviour among student population than the teacher population. It is anticipated that this study's findings can add the strong evidence of the validity and usefulness of the UTAUT model to the technology acceptance literature. Moreover, the practitioners with the help of this research's findings can guide the future integration of technology in higher education effectively.

Keywords: *Behavioural Intention, Technology Use Behaviour, UTAUT, Meta-analysis, Structural Equation Modelling*

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1. Introduction

The perspective on traditional education has already changed in the last few years in accordance with the advanced improvement of information and communication technology (ICT). As in traditional education, people cannot be educated only when they sit and learn physically in the classrooms. Owing to the rise of the internet and new technologies, most of the subjects or courses can be studied through staying at home called online learning or online education. Online learning is considered to be essential in the 21st century and its popularity increases more radically among the people all across the world. It is said in a most recent survey from Babson Survey Research Group that over 30 percent of higher education students in the United States take at least a distance course through online learning (Josep, 2021). Not only in the United States but also all over the world, the number of people who study online increases day by day because of the coronavirus pandemic, which started in December 2019 in China. According to an article from Insider, Zoom, a teleconferencing application typically used by businesses, has become the hot new way for people to connect and study online while social distancing during the coronavirus pandemic (Gilbert, 2020). In Myanmar, online learning has been popular among the students for the past few years. According to Kathryn online university, an online learning university in Myanmar, there are over 4000 students studying and 60 percent of them are from underdeveloped cities (Kathryn, 2021). During the pandemic, an unbreakable piece of evidence is that the popularity of online learning has increased more and more in the country.

In order to study online, there can be found many online learning platforms and some of the best and most popular ones include Coursera, Skillshare, Udemy, Codecademy, Edx, Pluralsight, Future Learn and Moodle. These are the ones leading the e-learning industry, which has been growing fast especially since the advent of COVID-19. According to a description in LearnWorlds, the number of people becoming interested in online learning is increasing both for learning and teaching purposes - to either learn a new skill or teach online. An online learning platform is an information system that provides a safe learning environment where students can take online courses (Raouna, 2020). These platforms are also called ‘online learning marketplaces’ in which students can search for the course and pay for them directly through online payment. When these platforms are applied by the teachers to teach online, they are called ‘online course platforms’. Many students and teachers specializing in various subjects gather in

these platforms to learn or to teach. In online learning platforms and online course platforms, there are thousands of courses for various subjects. For instance, a popular online learning platform, Future Learning includes various subjects and educational subjects are one of the best courses.

Before introducing online learning to students, it has become necessary to know technology acceptance of learners. In order to approach the digital learning environment, students' digital literacy and competency must be taken into consideration (Nelson et al., 2011). Kennedy et al. (2008) inquired about a few factors related with the student's use of technology in learning and their competency. Moreover, Goodyear and Ellis (2008) and Teo (2011) also studied about the impact of technology on students, teachers and their teaching-learning process. Jacobsen et al. (2013) also did a review on technology enhanced learning environment in higher education. With the results of many studies done by the researchers, many theories and models studying technology acceptance evolved in the literature: Theory of reasoned action by Fishbein and Ajzen in 1975, Theory of planned behaviour by Ajzen in 1985, Technology Acceptance Model by Davis in 1986 and Innovative Diffusion Theory by Rogers in 1983 (Lai, 2017). These models explain immediate and indirect effects on actual usage behaviour. Venkatesh et al. (2003) combined these and other models (The motivation model and PC utilisation), forming an integrated theory of technology acceptance called unified theory of acceptance and use of technology. While several models have been used in several studies, the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003) has become very popular.

With its popularity, UTAUT has been widely used in studying technology acceptance and usage behaviour of students. The problem found in several researches highlighted that more accurate interpretation or consistent generalization has become an urgent need in the research field. In order to give out consistent result by combining various results from different studies, meta- analysis is used. Meta analysis is a robust tool for statistical analysis by combining the results of multiple scientific studies with the approach of the aggregation of information from previous studies leading to a higher statistical power. For identifying a model, a technique called structural equation model is used.

There have been many meta-analysis studies for UTAUT model in several different fields. In higher education field, meta-analysis studies for technology acceptance are found to be conducted mostly for students. However, there is still a little synthesis research for technology acceptance of teachers in higher education. In order to create a successful digital learning

environment, technology acceptance and competency are important both for students and teachers. Therefore, this study will weigh both for students and teachers as to how much influence technology acceptance has on a successful digital learning environment by giving out an organized and consistent result using a meta-analysis approach. Therefore, through the use of the MASEM technique, this study is aimed to identify whether the UTAUT model is capable of explaining the technology acceptance of teachers and students in higher education.

The main aim of this study was to confirm the validity of the unified theory of acceptance and use of technology (UTAUT) in higher education context via meta-analytic structural equation modelling approach. According to the UTAUT model (Venkatesh et al., 2003); the following **Research Hypotheses** are formulated:

H1: Performance expectancy significantly predicts the behavioural intention to use technology in higher education context.

H2: Effort expectancy significantly predicts the behavioural intention to use technology in higher education context.

H3: Social influence significantly predicts the behavioural intention to use technology in higher education context.

H4: Facilitating conditions significantly predict the behavioural intention to use technology in higher education context.

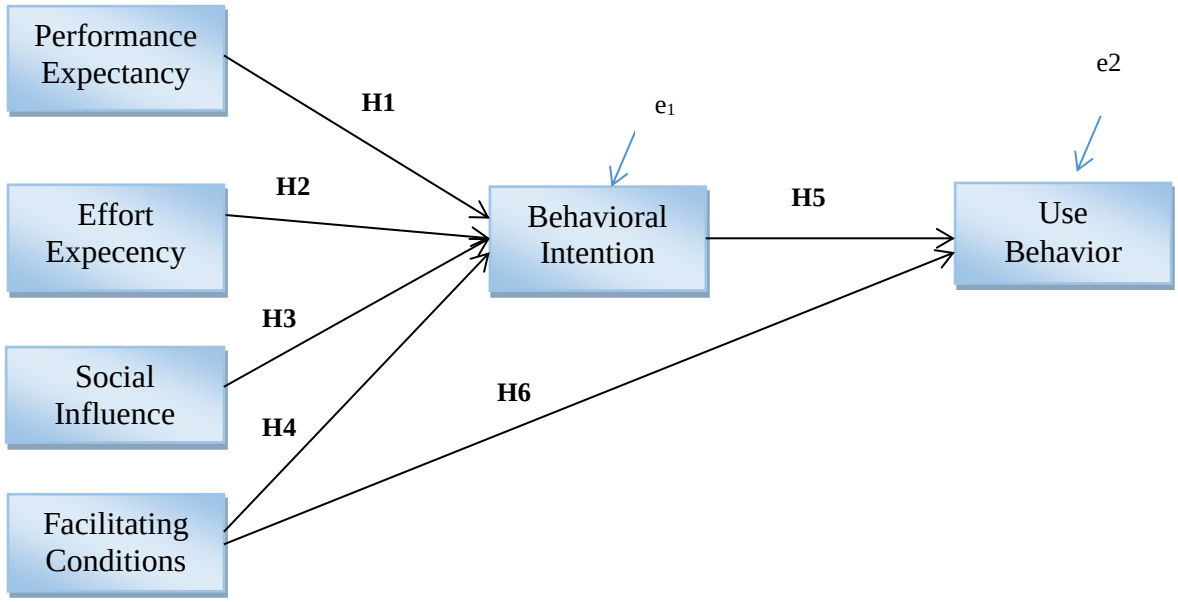
H5: Behavioural intention significantly predicts the actual technology use behaviour in higher education context.

H6: Facilitating conditions significantly predict the actual technology use behaviour in higher education context.

The **proposed conceptual model** of the factors influencing the actual technology use behaviour, in light of the UTAUT model (Venkatesh et al., 2003), is shown in Figure 1.

Figure 1

The Proposed Conceptual Model of Factors Influencing Actual Technology Use Behavior



2. Literature review

2.1. Technology Acceptance

After Covid-19 pandemic breakout, E-learning has attracted considerable interest among researchers (Wang et al., 2019; Vasconcelos et al., 2020; Vershitskaya et al., 2020). The reason is that it has the ability to transform learning and broaden its scope to reach more people. It is undeniable that e-learning is empowering, efficient, cost-friendly, and sustainable (Abdekhoda et al., 2016). With its advanced demand of digital learning environment, researches on the other hand, highlight the importance of technology acceptance of students. In 2003, Biggs argues that: "*if students are to learn desired outcomes in a reasonably effective manner, then the teacher's fundamental task is to get the students to engage in learning activities that are likely to result in their achieving those outcomes….what the student does in determining what is learned is more important than what the teacher does*". Moreover, in the study conducted by Ramsden (1998), there is substantial evidence to suggest students' perceptions of teaching have a profound impact on their approaches to learning and the quality of what they learn. The success of e-learning systems is dependent on their usage and acceptance by students and instructors that, if high, will increase the return on the investments higher education institutions make in such systems (Sharma et al., 2017).

Teo (2011) describes technology acceptance as the user's willingness to employ technology for the tasks it is designed to support. Researchers have become more interested in understanding the factors influencing the adoption of technologies in various settings over the years. It is also found in most of the acceptance studies that researchers have also sought to identify and understand the forces that shape users' acceptance so as to influence the design and implementation process in ways to avoid or minimize resistance or rejection when users interact with technology. As a result, models of acceptance have emerged, some extending the theories from psychology focused on the attitude-intention paradigm in explaining technology usage, which allowed researchers to predict user acceptance of potential technology applications.

2.2 Emergence of Different Technology Acceptance Models

In the 21st century, technology is playing the main role in the teaching and learning process. As a result, some researchers have been studying students' readiness in their acceptance of technology in learning for a couple of years. According to the findings of some researches, many models of technology acceptance have been found to date. They are: Theory of Reasoned Action, Technology Acceptance Model, Motivational Model, Theory of Planned Behavior, A Combined Theory of Planned Behavior and Technology Acceptance Model, Model of Personal Computer Use, Innovations Diffusion Theory and Social Cognitive Theory.

2.3 The Unified Theory of Acceptance and Use of Technology

Based on the eight models, which appeared in the 1990s, Venkatesh et al. (2003) introduced the Unified Theory of Acceptance and Use of Technology (UTAUT). The purpose of the UTAUT was to create a model that represents a more unified view of the technology acceptance process. The UTAUT model compared the predictability of this model to many similar technology acceptance models in the seminal paper that first introduced their unified model (Venkatesh et al., 2003). They found the model to account for only 70% of the variance in behavioral intention to use and only about 50% in actual use (Venkatesh et al., 2012).

The model made a comparison between several technology models, which were of concern to the technology acceptance process including the Theory of Reasoned Action (TRA), the TAM, the Motivational Model, the Theory of Planned Behavior (TPB), the combined TAM and TPB, the Model of PC Utilization (MPCU), the Innovation Diffusion Theory, and the Social Cognitive Theory (Venkatesh et al., 2003). By reviewing all eight models simultaneously

through multiple studies, they managed to pinpoint the key components from each model and combine them into a more unified theory, the UTAUT. In their initial study, results suggested strong support for the four constructs described as direct determinants of user acceptance and usage (operationalized as behavioral intention and user behavior).

According to UTAUT, there are determining factors that directly affect intention or use in models combined within the UTAUT framework. These determining factors are called performance expectancy (PE), social influence (SI), effort expectancy (EE) and facilitating conditions (FC). In addition, UTAUT includes four intermediate individual variation variables, gender, age, experience and voluntariness of use, which predict the relationship between primary factors and behavioral intention and use behavior. Indeed, that UTAUT was able to account for 70 percent of the variance in usage intention (Venkatesh et al., 2003). Their results also suggested strong support for several moderators including gender, age, year of experience, and willingness to use the technology. Overall, the UTAUT is a theory that synthesizes what is known concerning the topic of the technology acceptance process.

Venkatesh et al. (2003) explained these four constructs on his original example using a Personal Computer (PC). **Expectation of performance** refers to "*the degree to which an individual believes that using the system will help him or her to attain gains in job performance*". For example, what use does a PC generate for the employees? **Expectation of effort** refers to "*the degree of ease associated with the use of the system*". For example, how much effort do employees have to contribute to using a PC? **Social influence** refers to "*the degree to which an individual perceives that important others believe he or she should use the new system*". For example, what do the colleagues and superiors of the employees say about using a PC? **Facilitating conditions** refers to "*the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system*". For example, do the employees know how to use a PC? The first three constructs are direct determinants of the intention to use new technology. Facilitating conditions is a direct determinant of the intention to use a new technology and user behaviour. Therefore, the behavioural intention also serves as the mediator between the facilitating conditions and the user behavior.

In the model UTAUT, it incorporated significant factors of formerly established theories such as such as TAM, TRA, TPB and so on and established four key determinants of individual technology adoption, which are performance expectancy (PE), effort expectancy (EE), social

influence (SI) and facilitating conditions (FC) mediated by behavioral intention to use in predicting actual technology utilization behavior.

2.4 Previous Meta-analysis Studies on the UTAUT Model

Starting from the establishment of the UTAUT model by Venkatesh, Morris, Davis, and Davis in 2013, there have been many empirical studies in various fields of technology application utilizing different versions of the UTAUT models. From 2010 onwards, there have also been many meta-analysis studies synthesizing results of empirical studies of UTAUT model in several different fields. Some studies analyse all empirical studies utilizing the original UTAUT model while some analyse its modified versions. Various fields of ICT applications utilized meta-analysis technology for confirming the validity of the UTAUT model and for making some useful modifications of this model in their respective fields. Therefore, over ten meta-analysis studies on the UTAUT model have evolved for investigating the factors influencing the acceptance and use of technology during one decade starting from 2011 until 2021.

Yogesh K. Dwivedi, a Professor of Digital Marketing and Innovation, has published many meta-analysis papers on the UTAUT model in the area of Information Systems. In 2011, he and his colleagues conducted a meta-analysis study by synthesizing the sample size, correlation coefficients and overall variance explained from all empirical studies utilizing the UTAUT model. Moreover, Dwivedi et al. (2017) used a combination of meta-analysis and structural equation modelling (MASEM) techniques for explaining the acceptance and use of information system and information technology innovations. In 2019, Dwivedi and other scholars conducted a review for the theoretical addition of the variable “Habit” into the extended UTAUT model. In addition, Dwivedi et al. (2020) also made a comprehensive review of the above UTAUT and meta-UTAUT models for revising the UTAUT model with endogenous mechanisms and new moderating mechanisms in the field of information technology.

In the field of technology adoption and use, there are also other meta-analysis studies confirming the UTAUT models with some innovations (Taiwo & Downe, 2013; Sammarraie et al, 2013; Khechine et al, 2016; & Blut et al, 2021). In the field of Korean ICT service industries, Hwang and Lee (2018) synthesized the results of 69 published papers in Korean journals for confirming the variables in the UTAUT model. In economic field, Jadil et al. (2021) also

synthesized the empirical findings from 127 mobile banking studies with the focus on the UTAUT model for investigating the predictors of mobile banking (m-banking) adoption.

In higher education field, meta-analysis studies for technology acceptance are found to be conducted mostly for students, but a few for teachers. Most of the meta-analysis studies of technology acceptance in higher education field are based on the TAM model. However, there is still a little synthesis study on the UTAUT model for explaining the technology acceptance of both students and teachers in higher education. In order to create a successful digital learning environment, technology acceptance and competency are important both for students and teachers. Therefore, this study will try to synthesize the previous studies focusing the UTAUT model in higher education field by giving out an organized and consistent result using a meta-analysis approach.

3. Methodology

3.1 Research Design

Meta-analytic structural equation modelling approach was used in this study for the confirmation of the Unified Theory of Acceptance and Use of Technology developed by Venkatesh, et al. (2013) in the higher education context. For synthesizing the prior research findings on the UTAUT constructs, meta-analysis and structural equation modelling techniques were used in combination to test the UTAUT model in higher education context.

3.2 Data Collection Process

The data collection process begins with searching for the studies by identifying the keywords, search period and search engines, followed by specifying the selection criteria, selection process, and then ends with extracting data in excel file together with the study characteristics. The detailed procedures are clearly described in the each step.

3.2.1 Searching for the studies

As the UTAUT model was first developed by Venkatesh et al. (2003), the search period of the relevant studies covered from 2003 to June 2021, both included. Studies were collected via available search engines: Google, Google Scholar, Research Gate, Academia and Eric. In searching the relevant studies, the keywords “Unified theory of acceptance and use of technology in higher education”, “Students’ acceptance of technology in higher education”, “ICT acceptance of teachers in higher education”, and “Technology use in higher education” were used. In

addition, the references of the studies retrieved were also checked in order to get additional studies compatible with the selection criteria.

3.2.2 Selection Criteria of the Studies

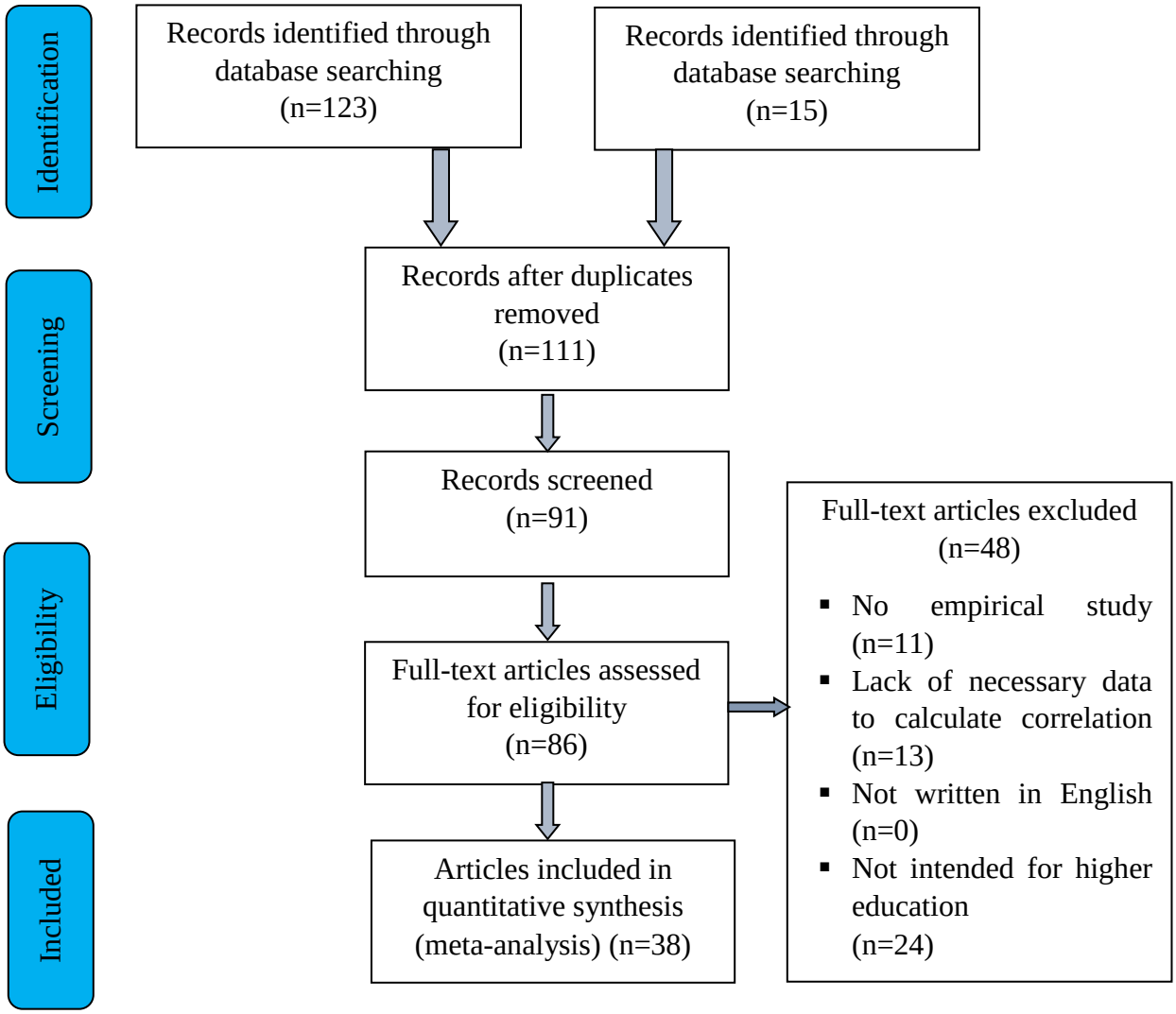
Inclusion criteria for this study was formulated as following: (a) to be an empirical study (i.e., survey), (b) to be the study presenting correlation coefficients or the necessary data to calculate the correlation; (c) to be written in English; and (d) to be the study conducted in higher education setting.

3.2.3 Selection Process of the Studies

Figure 2 shows a flowchart describing the selection process of the studies.

Figure 2

Flowchart of the Selection Process of Studies for the Present Meta-analysis



3.2.4 Data Extraction

In order to know how study characteristics affect the relationships between the study constructs if heterogeneity exists, the following additional variables were also extracted for coding: target population (teachers coded as 1 and students coded as 2), sample size, year of the study and geographic location of the study (country). Among these study variables, target population is assumed as the main target variable for heterogeneity of the effect sizes across the studies because teachers' technology acceptance may not be the same with that of students due to age difference.

Table 1

Summary of Previous Studies using UTAUT Constructs in Higher Education Field

Study	Author	Year	Country	Sample	N
1	Kurt, Ozlem, Tingoy & Ozhan	2017	Turkey	2	610
2	Kurt, Ozlem, Tingoy & Ozhan	2017	England	2	622
3	Vankatesh, Thong & Xu	2012	Hongkong	2	1512
4	Liebenberg, Benade & Ellis	2018	South Africa	2	738
5	Harris	2016	United States	1	111
6	Amadin, Obienu & Osaseri	2018	Nigeria	1	200
7	Pinochet, Nunes & Herrero	2019	Brazil	2	419
8	Altalhi	2021	Saudi Arabia	1	150
9	Alasmari	2017	Saudi Arabia	2	1185
10	Moran, Hawkes, & Gayar	2010	United States	2	263
11	Lewis, Fretwell, Ryan & Parham	2013	United States	1	46
12	Schaik (Study 1, VLE)	2009	England	2	118
13	Schaik (Study 1, Library Website)	2009	England	2	118
14	Schaik (Study 2, Library Website)	2009	England	2	118
15	Schaik (Study 2, Goal Mode)	2009	England	2	118
16	Schaik (Study 2, Action Mode)	2009	England	2	118
17	Isaac, Abdullah, Aldholay & Ameen	2018	Yemen	1	508
18	Gogus, Nistor, & Lerche	2012	Turkey	1	1723

Study	Author	Year	Country	Sample	N
19	Alowayr & Azawei	2021	Saudi Arabia	2	246
20	Abdallah, Abdallah, & Bohra	2021	Palestine	2	218
21	Naveed, Alam, & Tairan	2020	Saudi Arabia	2	386
22	Nawaz, & Mohamed	2020	Sri Lanka	2	453
23	Almaiah, Alamri, & Al-rahmi	2019	Jordan	2	697
24	Nassuora	2013	Saudi Arabia	2	80
25	Abu-Al-Aish	2014	England	2	174
26	Alharbi, Alotebi, Masmali & Alreshido	2017	Saudi Arabia	1	83
27	Chaka, & Govender	2017	Nigeria	2	320
28	Ahmet	2014	Turkey	2	561
29	Alhramelah, & Alshahrani	2020	Saudi Arabia	2	167
30	Wai Wai Than & Nu Nu Khaing	2020	Myanmar	2	412
31	Alshehri, Rutter & Smith	2020	Saudi Arabia	2	605
32	Oye, Iahad & Rahim	2011	Nigeria	1	100
33	Imarah, Zwain, & Al-Hakim	2013	Iraq	1	430
34	Alshmrany, & Wilkinson	2017	Saudi Arabia	1	170
35	Thomas, Singh & Gaffar	2013	Guyana	2	322
36	Abu-Al-Aish, & Steve Love	2013	England	2	174
37	Khechine & Augier	2019	France, United States, China, Brazil	2	99
38	Elkaseh, Wong, & Fung	2015	Libya	2	318
39	Elkaseh, Wong, & Fung	2015	Libya	1	182
40	Raman, Don, Khalid, Hussin, Omar, & Ghani	2014	Malaysia	1	68
41	Salloum, Maqableh, Mhamdi, Kurdi, & Shaalan	2018	United Arab Emirates	2	333
42	Moonkyoung, Milla, Seongcheol, & Shahrokh	2020	Korea, Finland	2	368
43	Dakduk, Banderali, & Woude	2018	Colombia	1	307
44	Maina, & Nzuki	2015	Kenya	2	600

After selecting the appropriate studies for meta-analysis using the eligibility criteria, 44 samples (16550 participants in higher education institutions) from 38 studies conducted in 24 countries were included in the current meta-analysis study.

3.3 Statistical Analysis

The research objective was undertaken by the combination of two advanced statistical techniques: meta-analysis and structural equation modelling. After synthesizing the quantitative findings from previous research studies, path analysis was conducted by means of SEM techniques for assessing the research hypotheses, R studio (version 4.0.3), two stage meta-analytic structural equation modelling (TSSEM) was conducted by using the metaSEM package and the semPlot package.

In the first stage of TSSEM, the homogeneity of correlation matrices across studies were tested and assuming random effect and adding categorical moderators were considered if heterogeneity exists. Then, with univariate approach, pooled correlation matrix was estimated for further testing of the model. In the second stage, the resulted pooled correlation matrix was used as an observed covariance matrix in fitting the SEM model.

The validity of the proposed model can be proven with multiple chi-squared tests and the rate of change of a conditional mean was interpreted as a regression coefficient. In order to measure the goodness of fit indexes of the model, many different types of fit indexes including the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR) can be tested. In this study, only RMSEA value is presented.

4. Findings and Discussion

This study conducted the two stage meta-analytic structural equation modelling (TSSEM) for the purpose of confirming the original version of the Unified Theory of Acceptance and Use of Technology in the higher education context.

From the selected studies, total 472 independent correlation values among the constructs of the UTAUT model were obtained to calculate the pooled correlation matrix.

4.1 Pooling the Correlation Values by Meta-analysis Technique

In the first stage of the current TSSEM, independent correlation matrices and sample sizes from individual studies are imported to R as the input variables for checking heterogeneity and calculating the pooled correlation matrix. Using the Univariate approach, the pooled correlation matrix is then calculated.

Table 2

Pooled Correlation Matrix from Meta-analysis Result

	UB	**BI**	**PE**	**EE**	**SI**	**FC**
UB	1	10678 (22)	10081 (23)	10081 (23)	9633 (21)	9810 (17)
BI	.388***	1	15744 (41)	15962 (42)	14762 (40)	12579 (33)
PE	.416***	.527***	1	14329 (40)	13226 (37)	12051 (31)
EE	.377***	.456***	.539***	1	13444 (38)	12269 (32)
SI	.322***	.373***	.418***	.396***	1	12269 (32)
FC	.370***	.437***	.389***	.454***	.394***	1

Note. r_c *in lower triangle and N (k) in upper triangle*

**** p <.001*

r_c*=Pooled correlation values*

N= Number of participants for each correlation

k= Number of studies for each correlation

By means of meta-analysis technique, fifteen pooled correlation values among the study constructs were calculated and presented in the lower triangle of the matrix. In the upper triangle, the number of participants and the number of studies respective for calculating each correlation value were also presented. According to the result, it can clearly be seen that all correlation values were positive and significant at the .001 level, showing that all constructs of the UTAUT model are strongly correlated in the positive direction.

4.2 Fitting the Proposed Model with the Pooled Correlation Matrix by means of SEM technique

In the second stage of this TSSEM, pooled correlation matrix was used as the observed covariance matrix in fitting the proposed model of technology acceptance.

Table 3

Summary of Causal Effects for the Structural Model (Technology Use Behavior)

Outcome	Determinant	Causal Effects		
		Direct	Indirect	Total
BI	PE	.39*	-	.39*
(R^2=.63)	EE	.28*	-	.28*
	SI	.36*	-	.36*
	FC	.40*	-	.40*
UB	BI	.56*	-	.56*
(R^2=.32)	PE	-	.22*	.22*
	EE	-	.16*	.16*
	SI	-	.20*	.20*
	FC	-	.22*	.22*

*Note. * denotes significant paths t at p <.05.*

Examination of the RMSEA value for the proposed model is 0.1, which is not in the acceptable range of the model fit. Therefore, one path from the proposed model (FC ➔ UB) was removed from the model, and the result showed that the RMSEA value for the revised model is 0.08, which shows the best fit of the model with the observed data. The SEM result of the revised model showed that all four predictors, namely "performance expectancy", "effort expectancy", "facilitating conditions" and "social influence" had significant impact on students' behavioural intention to use mobile learning technology, explaining 63% of variance in it. However, facilitating conditions do not have a significant direct effect on actual use behaviour. Then, behavioural intention to use technology showed significant positive effect on students' actual use behaviour of technology, explaining about 32 % of variance in it.

Comparing with the previous meta-analysis studies on the UTAUT model, all meta-analysis studies in various fields confirmed the validity of the original UTAUT model with some modifications in some studies by adding new mediators. Many researches in the fields of

information systems and technology, technology innovation, Korean industries and mobile banking provided the evidence supporting the hypotheses formulated in this study (Dwivedi et al., 2011; Dwivedi et al., 2019; Hwang & Lee, 2018; Jadil et al., 2021). Dwivedi et. al. (2019) modified the UTAUT model by adding the mediator "attitude" connecting the four predictors with the intention and technology use. Therefore, this study's result is consistent with previous meta-analysis studies in the finding that all four predictors contribute to the behavioural intention and technology acceptance. However, there was an inconsistent finding that the predictor "facilitating conditions" show only the indirect effect on technology acceptance through the mediator "behavioural intention".

This inconsistent finding, otherwise, shows the complete mediation of behavioural intention between the facilitating conditions and technology acceptance. Although some studies in the literature emphasize that facilitating conditions have an effect on use behavior rather than behavioural intention (Venkatesh et al., 2003; Chiu & Wang, 2008; Wang & Shih, 2009; Taiwo & Downe, 2013), some researches in education field (Mtebe & Raisamo, 2014; Singh & Gaffar, 2013) had found that "facilitating conditions" construct had significant positive effect towards students' behavioural intention to use technology. Moreover, there have been many studies that confirmed the positive significant impact of facilitating conditions on behavioural intention to use technology in the higher education field (Samsudeen & Mohamed, 2019; Shen et al., 2019; Jameel et al., 2020). Also in this study, the "facilitating conditions" construct was the strongest predictor of behavioural intention. Because of the strong relationship between facilitating conditions and behavioural intention, it may be that behavioural intentions fully explain the mechanism between facilitating conditions and technology use behaviour. Therefore, it may be that FC showed only significant indirect effect on UB through the mediator of BI.

4.3 Explaining the Heterogeneity by Study Variable "Target Population"

All of the estimated heterogeneity values for all the correlation values in Table 3 are higher than 0.8, showing high level of heterogeneity in correlation matrices among different studies. A solution to heterogeneity in correlation matrices is to explain the heterogeneity using study characteristics by means of sub-group analysis. Therefore, sub-group analysis was calculated by using the target population (students vs. teachers), one of the study characteristic, as the moderator for explaining this heterogeneity.

Although this sub-group analysis cannot explain this heterogeneity completely, the division of the student and teacher groups can reduce the heterogeneity in the correlation matrices among the studies from high level to the medium level. Therefore, the following results for the student and teacher groups are more generalizable and accurate than the above overall result.

Table 4

Summary of Causal Effects, R^2 and Fit Index for the Final Model from Sub-group Analysis

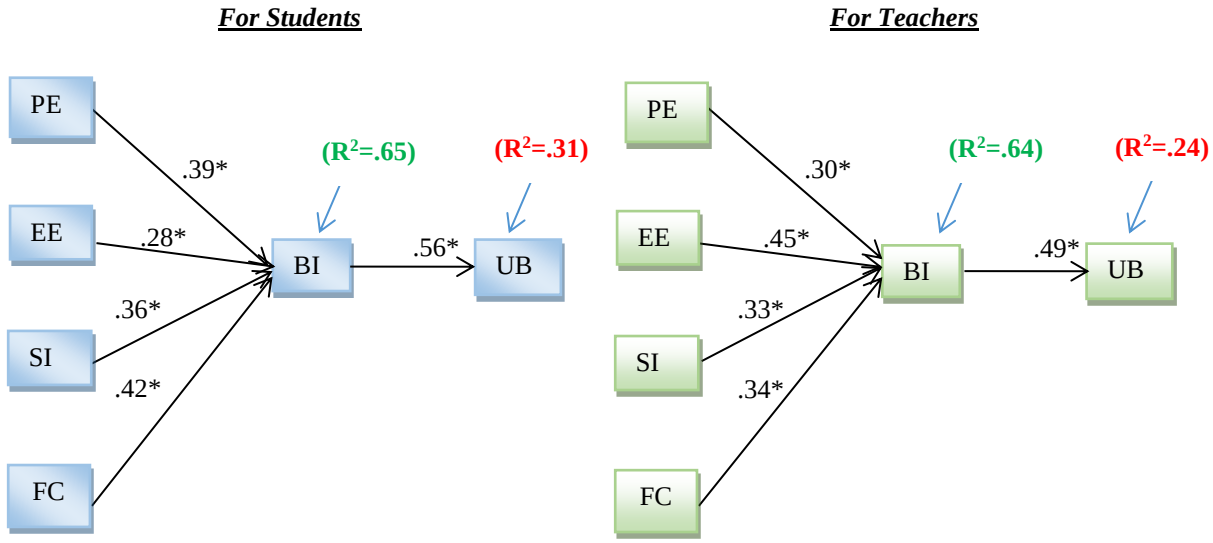
	Students	**Teachers**
	Standardized coefficient	**Standardized coefficient**
PE → BI	.392*	.297*
EE → BI	.279*	.449*
SI → BI	.360*	.328*
FC → BI	.418*	.341*
	R^2 = .65	**R^2 = .64**
BI → UB	.559*	.491*
	R^2 = .31	**R^2 = .24**
Model fit	**RMSEA = .079**	**RMSEA = .080**

*Note. * denotes significant paths t at p <.05.*

According to Table 4, the final model can explain about 31% of the variance of the technology use behaviour among student populations and about 24% of the variance of the technology use behaviour among teacher populations. By comparing them, the model can explain the technology use behaviour of students better than that of teachers. In explaining the variance in behavioural intention, the model works equally for both students and teachers by explaining about 65% of variance of behavioural intention. Another different finding is that the "facilitating conditions" construct was the strongest predictor for behavioural intention to use technology among the student population while the "effort expectancy" construct was the strongest among the teacher population.

Figure 3

Comparison of the resulted UTAUT models for Factors Influencing Technology Use Behaviour for Students and Teachers



5. Conclusion

The main aim of this study is to confirm the validity of the UTAUT model for explaining the factors influencing actual acceptance of technology among students and teachers in higher education setting. Hypotheses (1), (2), (3) and (4) proposed that four predictors, namely "learning expectancy", "effort expectancy", "social influence" and "facilitating conditions" have significant impact on students and teachers' behavioural intention to use technology. Hypotheses (5) and (6) proposed that facilitating conditions and behavioural intention to use technology have the significant effect on their actual use behaviour of technology. According to the result of MASEM on the quantitative synthesis of 44 studies covering 16550 participants (4078 teachers and 12472 students) in the higher education setting, all hypotheses, except Hypothesis (6), are confirmed, showing that all of the study constructs are significantly correlated. Therefore, it can be said that the independent predictors in the UTAUT model, "learning expectancy", "effort expectancy", "social influence" and "facilitating conditions", and the mediator "behavioural intention" can directly or indirectly explain the actual technology use behaviour of students and teachers in higher education. However, as the new finding, facilitating conditions showed no significant direct effect but only significant indirect effect on technology use behaviour through

the mediator of behavioural intention. As another new finding, the resulted model explained the technology use behaviour of students better than that of teachers.

This study's theoretical contribution goes to the literature of ICT integration theories, especially to the UTAUT model. It supports almost all of the hypotheses in the original UTAUT model: (a) learning expectancy, effort expectancy, social influence and facilitating conditions have direct positive effect on behavioural intention, and (b) behavioural intention has direct positive effect on actual use behaviour of technology, but (c) facilitating conditions had no significant direct effect on use behaviour. As a result, this study's findings can add strong evidence of the validity and explanatory power of the UTAUT model to the technology acceptance literature. Moreover, the future integration of ICTs and technology in higher education can be performed with the knowledge of the revised UTAUT model by emphasizing the four predictors.

Moreover, the results of this study also contribute practical implications to different stakeholders. Especially during the Covid-19 Pandemic Period, there is an urgent need for policy makers, university administrators and instructional designers to understand the influencing factors for technology use behaviour of both students and teachers in higher education. To successfully implement distance e-learning systems for higher education institutions which can increase the students' and teachers' behavioural intention and use of technology, university administrators and different stakeholders should take into consideration of the "performance expectancy", "effort expectancy", "social influence" and "facilitating conditions" factors by providing institutional support to students. Since performance expectancy and effort expectancy had effect on technology acceptance, practitioners should emphasize on the ease of use and usefulness of applied technology in the higher education context. For ensuring the social influence factor, practitioners should create sharing sessions for broad use of technology, and generate favourable words of mouth in using innovative technology in education. Finally, facilitating conditions is also a crucial one in the successful use of technology in learning. Technical and financial support such as media literacy, ICT knowledge, and data access should be provided to students. By considering all four predictors of the UTAUT model in collaboration, instructional designers should get insight to create mobile friendly instructional platforms and contents with the characteristics of interest, curiosity and enjoyment, which may cost as low as possible but increase learning rate. Higher education institutions also need to

develop strategic plans and guidelines for successfully integrating technology in education. For the above-mentioned implications, it is anticipated that this study may be a valuable one conducted during this pandemic period.

The present study has some limitations. First, this study only synthesizes the effect sizes for the relations between endogenous and exogenous variables in the original UTAUT model, but it ignores the effect sizes for the moderator variables such as gender, age, experience and voluntariness of use, which may predict the relationship between primary factors and behavioral intention and use behavior. Therefore, it reduces the explanation power of the resulted model for explaining the behavioral intention and use behavior of technology. Second, this study utilizes the univariate MASEM approach to get the pooled correlation matrix. In this approach, each pooled correlation value is based on a different subset of studies because of the missing values in the correlation matrices of the six variables in the including studies. This may create many disadvantages in fitting the SEM model. Finally, this study cannot explain completely the heterogeneity in the correlation matrices across different studies. The sub-group analysis using the study variable "target population (teachers vs students)" can only reduce the heterogeneity of the correlation matrices across studies to some extent. Therefore, many other study characteristics should be considered in explaining the heterogeneity of the correlation matrices in order to improve the generalizability and accuracy of the resulted model in explaining the technology use behavior in higher education.

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